PB88-172168

Superfund Record of Decision (EPA Region 8) Denver Radium Site, 11th and Umatilla Properties, Colorado (Sixth Remedial Action) September 1987

(U.S.) Environmental Protection Agency
Washington, DC

Prepared for

29 Sep 87

U.S. Department of Commerce
National Technical Information Service
NTIS

PB88-172168

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R08-87/015
September 1987

EPA

Superfund Record of Decision:

Denver Radium/11th & Umatilla, CO

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SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC INFORMATION

PB88-172168

Superfund Record of Decision (EPA Region 8): Denver Radium Site, 11th and Umatilla Properties, Colorado (Selected Remedial Action), September 1987.

29 Sep 87

PERFORMER: Environmental Protection Agency, Washington, DC.
EPA/ROD/R08-87/015

See also PB88-172143.Portions of this document are not fully legible.

The decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

KEYWORDS: *Industrial wastes, *Hazardous materials, *Waste disposal, *Superfund program, *Remedial actions, *Record of decision.

Available from the National Technical Information Service, SPRINGFIELD, VA. 22161

PRICE CODE: PC A03/MF A01

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA/ROD/R08-87/015	2.	3. RECIPIENT'S ACCESSION NO. PB88-172168
4. TITLE AND SUBTITLE SUPERFUND RECORD OF DECISION Denver Radium/11th and Umatilla, CO Sixth Remedial Action		5. REPORT DATE September 29, 1987 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Final ROD Report 14. SPONSORING AGENCY CODE 800/00
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The Denver Radium site, located in Denver, Colorado, consists of more than 40 contaminated properties. These properties have been grouped into eleven operable units. This operable unit consists of eleven Denver Radium site properties which are known collectively as the 11th and Umatilla properties. The 11th and Umatilla roperties site consists of approximately 24 acres in an area zoned for heavy industrial se. Two-thirds of the 11th and Umatilla properties are located within the designated 100-year flood plain. In 1979 EPA noted a reference to the National Radium Institute (NRI) in a 1916 U.S. Bureau of Mines report. This reference revealed the presence of 31 radioactive sites in the Denver metropolitan area. In 1913 the NRI was established in Denver as a domestic source of radium, which was in high demand as a wonder drug for the treatment of cancer. Subsequently, the Denver radium, vanadium and uranium industry thrived until the early 1920s, when rich deposits of ore were discovered in Africa. The Schlesinger Radium Company and its successor, Radium Company of Colorado, produced radium on the 11th and Umatilla properties from 1915 to 1921 and is considered to be the source of contamination of the eleven 11th and Umatilla properties. There are approximately 15,400 yd^3 of contaminated material of which 1,000 yd^3 lie under structures and material and 11 ft^2 consist of contaminated roofing from the Rocky Mountain Research building. The primary contaminants of concern are radium, radon gas (See Attached Sheet)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Denver Radium/11th and Umatilla, CO Sixth Remedial Action Contaminated Media: soil, air, debris Key contaminants: radium, radon gas and associated decay products		

DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report) None	21. NO. OF PAGES 38
	20. SECURITY CLASS (This page) None	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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DECLARATION
FOR THE
RECORD OF DECISION

Site Name

11th and Umatilla Properties
Operable Unit II
Denver Radium Site

Site Location

11th Avenue and Umatilla Street
Denver, Colorado

Statement of Purpose

This decision document presents the selected remedial action for this operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300).

The State of Colorado has concurred on the selected remedy. (See attached letter.)

Statement of Basis

This decision is based upon the administrative record for the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

Description of the Selected Remedy

This Record of Decision addresses the contamination present on the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site. This is the sixth operable unit of the Denver Radium Site for which EPA has selected a remedy. EPA is undertaking additional feasibility studies to evaluate remedial action alternatives at the other Denver Radium Site operable units and will complete a Record of Decision or an Action Memorandum for each of the operable units for which a remedy has not already been selected.

Radium and its associated decay products are the hazardous substances of primary concern that have been released and continue to be released into the environment at the 11th and Umatilla properties. Long-term exposure to radium and its decay products has been shown conclusively to increase the risk of contracting lung cancer.

EPA's preferred remedial action alternative for the 11th and Umatilla properties is Offsite Permanent Disposal. However, until a facility suitable for permanent disposal of the 11th and Umatilla properties material is designated and, if necessary, acquired and developed, this alternative cannot be implemented. Pursuant to CERCLA Section 104(c)(3)(C)(ii), it is the responsibility of the State of Colorado to assure the availability of a facility for offsite disposal of the 11th and Umatilla properties material. Although both EPA and State of Colorado are continuing to seek a permanent disposal site, the State estimates that this process could take up to five years. Given the length of time which may pass before the State assures the availability of an offsite permanent disposal facility, and in order to prevent or minimize the threat to public health and the environment, EPA has determined that a remedial action alternative which includes temporary response actions should be implemented at the 11th and Umatilla properties.

The selected remedy for the 11th and Umatilla properties is Onsite Temporary Land Storage, Offsite Permanent Disposal. This remedial action alternative will attain a degree of cleanup of the hazardous substances which will assure both short-term and long-term protection of human health and the environment. The present-worth cost of this alternative is $4,230,300 based upon a ten-percent interest rate, a five-year discount period, and a perpetual monitoring period. This alternative entails:

- excavating the contaminated soil from the open areas and from under the buildings on the 11th and Umatilla properties and placing this material in a temporary land-storage facility to be constructed on the 11th and Umatilla properties;

- decontaminating the approximately 11 square feet of contaminated roof in the Rocky Mountain Research building and placing this material in the temporary land-storage facility;

- maintaining the concrete cap which already covers a portion of the contaminated material present on the DuWald Steel property;

- maintaining the temporary land-storage facility until a facility suitable for the permanent disposal of Denver Radium Site wastes becomes available; and

- final removal of the estimated 15,400 cubic yards of contaminated material from the temporary land-storage

facility and from under the concrete cap to the permanent disposal facility.

Remedial Design for this operable unit will include the selected remedy described above and EPA's preferred remedial action alternative, Offsite Permanent Disposal. Should the State of Colorado fulfill its obligation to assure the availability of a suitable disposal facility for material from the Denver Radium Site by the time EPA has concluded Remedial Design for the 11th and Umatilla properties, EPA may implement its preferred alternative, Offsite Permanent Disposal.

Operation and maintenance activities will be required to ensure the effectiveness of the temporary response actions. These activities include site inspections, ongoing radiological monitoring, and possible minor repairs to the concrete cap which is already in place on the DuWald Steel property or the temporary land-storage facility to be constructed on the 11th and Umatilla properties. Also included as an operation and maintenance activity for cost estimating purposes is a review of the properties which, pursuant to SARA Section 121(c), must be conducted no less than every five years if a remedial action is selected that results in any hazardous substances remaining onsite. Since EPA does not anticipate that any hazardous substances will remain onsite longer than five years, the cost of this review is considered a contingency. The maximum total of the discounted annual operation and maintenance costs of these activities using a five-year discount period and a ten-percent discount rate is $194,700. This operation and maintenance cost is included with the present-worth total alternative cost mentioned above.

Declarations

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300), I have determined that the selected remedy for the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site, is protective of human health and the environment, attains Federal and State public health and environmental requirements that are applicable or relevant and appropriate, and is cost-effective.

The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. Even though the remedy does not satisfy the statutory preference for treatment which reduces the toxicity, mobility, or volume of hazardous substances as its principal element, the principal threat at the properties will be addressed. Treatment was determined to be impracticable based upon effectiveness, technical feasibility, implementability, and cost factors.

James J. Scherer
Regional Administrator
EPA Region VIII

Sept. 29, 1987
Date

RECORD OF DECISION
SUMMARY

Site Name

11th and Umatilla properties
Operable Unit II
Denver Radium Site

Site History

The Denver Radium Site has its beginnings with the United States radium, vanadium, and uranium producing industry of the early 1900s. Radium was first discovered in the late 1800s and was highly valued for medicinal purposes.

Prior to 1914, radium-bearing ore was shipped from the United States to Europe where it was refined. The possibility of war in Europe threatened to disrupt the United States' importation of radium and prompted the development of a domestic refinement process. The United States Bureau of Mines entered into a cooperative agreement with a private corporation establishing the National Radium Institute which successfully developed and operated a radium processing plant in the United States.

Denver was chosen as the location of the National Radium Institute facility due to its proximity to the Colorado Plateau, which contained rich deposits of the radium-bearing ore, carnotite. Soon numerous radium, vanadium, and uranium processing operations opened in Denver. In 1915, one of these producers, the Schlesinger Radium Company, began operations on the property which is currently part of Operable II of the Denver Radium Site. Schlesinger Radium Company apparently became the Radium Company of Colorado in 1917. The Radium Company of Colorado was one of Denver's major producers of radium, reportedly processing between 1,000 and 1,200 tons of carnotite a year.

The Denver radium, vanadium, and uranium industry remained strong until the early 1920s when extremely rich deposits of ore were discovered in what was then the Belgian Congo. The Denver producers were unable to remain economically competitive and the industry in Denver collapsed. The Radium Company of Colorado reportedly ceased operations in 1921.

Response History

In 1979, EPA noted a reference to the National Radium Institute in a 1916 United States Bureau of Mines report. Subsequent field research revealed the presence of thirty-one radioactive sites in the Denver metropolitan area, two of which are now included with the 11th and Umatilla properties, the original location of the mill operated by the Radium Company of Colorado (Figure 1).

Immediately after identifying these properties, the Radiation Control Division of the Colorado Department of Health officially notified the affected property owners of the presence of radiological contamination on their properties. The letters requested that no excavation or soil movement be undertaken without first contacting the Division.

In August, 1981, the Colorado Department of Health, under a cooperative agreement with EPA, assumed lead activities and initiated engineering assessments of the majority of the original 31 properties. In October, 1981, shortly after the cooperative agreement was awarded to the State, the Denver Radium Site was placed on the Interim Priorities List. The Site was included on the Final National Priorities List promulgated on September 8, 1983.

EPA resumed Fund-lead activities in June, 1983, because the Colorado State Legislature failed to appropriate the State cost share for remedial planning required by EPA at the time. In December, 1983, EPA directed its contractor to conduct a Remedial Investigation (RI) of the Denver Radium Site to determine the nature and extent of the contamination present on those properties which the State did not previously study plus several contiguous properties where additional contamination was suspected. EPA also directed its contractor to conduct a Feasibility Study (FS) of each operable unit to evaluate proposed remedies for the contamination present on all of the Denver Radium Site properties which, with the addition of the contiguous properties, totaled over 40 properties.

Because of the enormity and complexity of the Denver Radium Site, EPA determined that response actions undertaken in operable units would be cost-effective and consistent with a permanent remedy for the entire Denver Radium Site. Thus, the original Denver Radium Site properties plus the contiguous properties where contamination was discovered subsequent to the initial listing of the Site on the Interim Priorities List were divided into eleven operable units, the 11th and Umatilla properties being Operable Unit II. The properties were divided based primarily upon site conditions and proximity to other Denver Radium Site properties.

In April, 1986, the Denver Radium Site Remedial Investigation Report, which addresses all eleven operable units, was released to the public. The draft Operable Unit II FS was

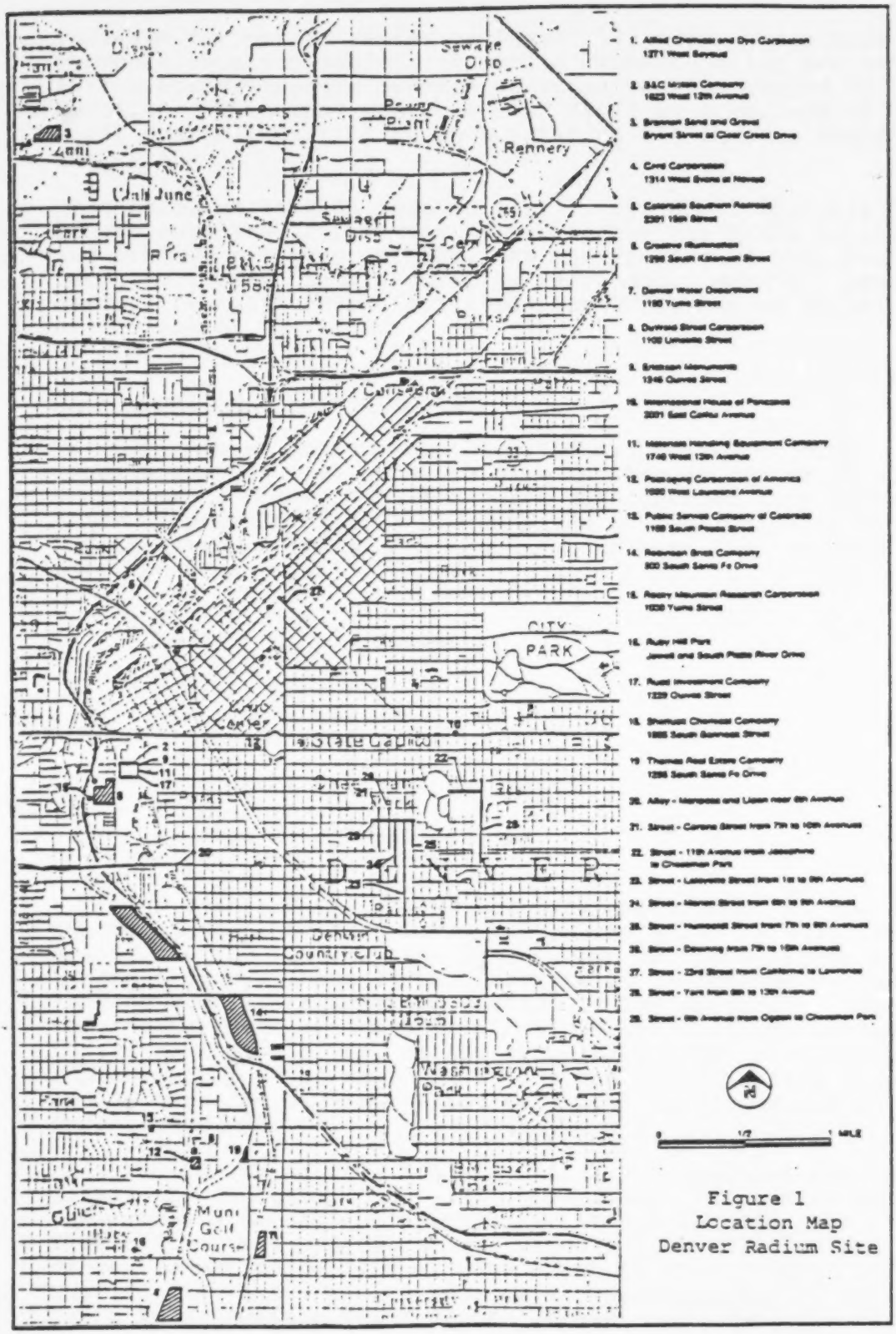
Sewage Disp.
Power Plant
Refinery
Union Pac. RR
Sewage Disp.
Cemetery
CITY PARK
Country Club
Golf Course
1. Allied Chemical and Dye Corporation
1271 West Bayaud
2. BAC Metals Company
1623 West 12th Avenue
3. Brannan Sand and Gravel
Bryant Street at Clear Creek Drive
4. Cord Corporation
1314 West Bruns at Hirado
5. Colorado Southern Railroad
2301 19th Street
6. Crowne Illumination
1298 South Kalamath Street
7. Denver Water Department
1160 Yuma Street
8. Durweld Street Corporation
1100 Umatilla Street
9. Erickson Monuments
1346 Quivas Street
10. International House of Pancakes
2001 East Colfax Avenue
11. Materials Handling Equipment Company
1740 West 13th Avenue
12. Packaging Corporation of America
1000 West Louisiana Avenue
13. Public Service Company of Colorado
1168 South Platte Street
14. Robinson Brick Company
800 South Santa Fe Drive
15. Rocky Mountain Research Corporation
1630 Yuma Street
16. Ruby Hill Park
Jewell and South Platte River Drive
17. Rust Investment Company
1229 Quivas Street
18. Sherlock Chemical Company
1885 South Bannock Street
19. Thomas Real Estate Company
1295 South Santa Fe Drive
20. Alley - Mariposa and Lipan near 6th Avenue
21. Street - Corona Street from 7th to 10th Avenues
22. Street - 11th Avenue from Josephine to Cheesman Park
23. Street - Lafayette Street from 1st to 9th Avenues
24. Street - Marion Street from 6th to 9th Avenues
25. Street - Humboldt Street from 7th to 8th Avenues
26. Street - Downing from 7th to 15th Avenues
27. Street - 23rd Street from California to Lawrence
28. Street - York from 6th to 13th Avenue
29. Street - 6th Avenue from Ogden to Cheesman Park
N
0
1/2
1 MILE

Figure 1
Location Map
Denver Radium Site

released for public review on August 14, 1987. Responses to comments received during the public comment period are contained in the Responsiveness Summary attached to this Record of Decision. The final Operable Unit II FS is comprised of the draft Operable Unit II FS incorporating the changes described in the errata.

Pursuant to SARA Section 104(i), the draft Operable Unit II FS was submitted for review by the Agency for Toxic Substances and Disease Registry (ATSDR). At the signing of this Record of Decision, ATSDR had not formally responded. However, preliminary discussions with ATSDR indicated that ATSDR had no major criticisms of the report.

Site Location and Description

The Denver Radium Site, located in Denver, Colorado, (population 509,000) consists of more than 40 contaminated properties. These properties have been grouped into operable units. Operable Unit II is comprised of the following Denver Radium Site properties known collectively as the 11th and Umatilla properties:

- DuWald Steel
- Rocky Mountain Research
- G & K Services
- Jenkins property
- Staab building
- Air Conditioning, Inc.
- Jerome Park Maintenance Yard
- Burlington Northern Railroad
- Flame Spray, Inc.
- Capital Management Reality
- Alpha Omega Electronics

The 11th and Umatilla properties are bounded on the east by the Burlington Northern Railroad, on the north by West 11th Avenue, on the west by Yuma Street, and on the south by West 10th Avenue (Figures 2 and 3). Interstate-25 is located approximately 75 feet west of the western portion of the property. The Denver Water Department Headquarter's offices and facility are adjacent to the southeast corner of the properties. The properties cover approximately 24 acres in an area zoned I-2 for heavy industrial use. There are several buried municipal utilities within the property boundaries.

Two-thirds of the 11th and Umatilla properties are located within the designated 100-year floodplain. The entire area of the 11th and Umatilla properties is within the 500-year floodplain. The properties are underlain by alluvium and the Denver formation sandstone. The depth to ground water is greater than 10 feet and depth to bedrock is approximately 10 to 30 feet. There is no surface water on the properties. The climate of the

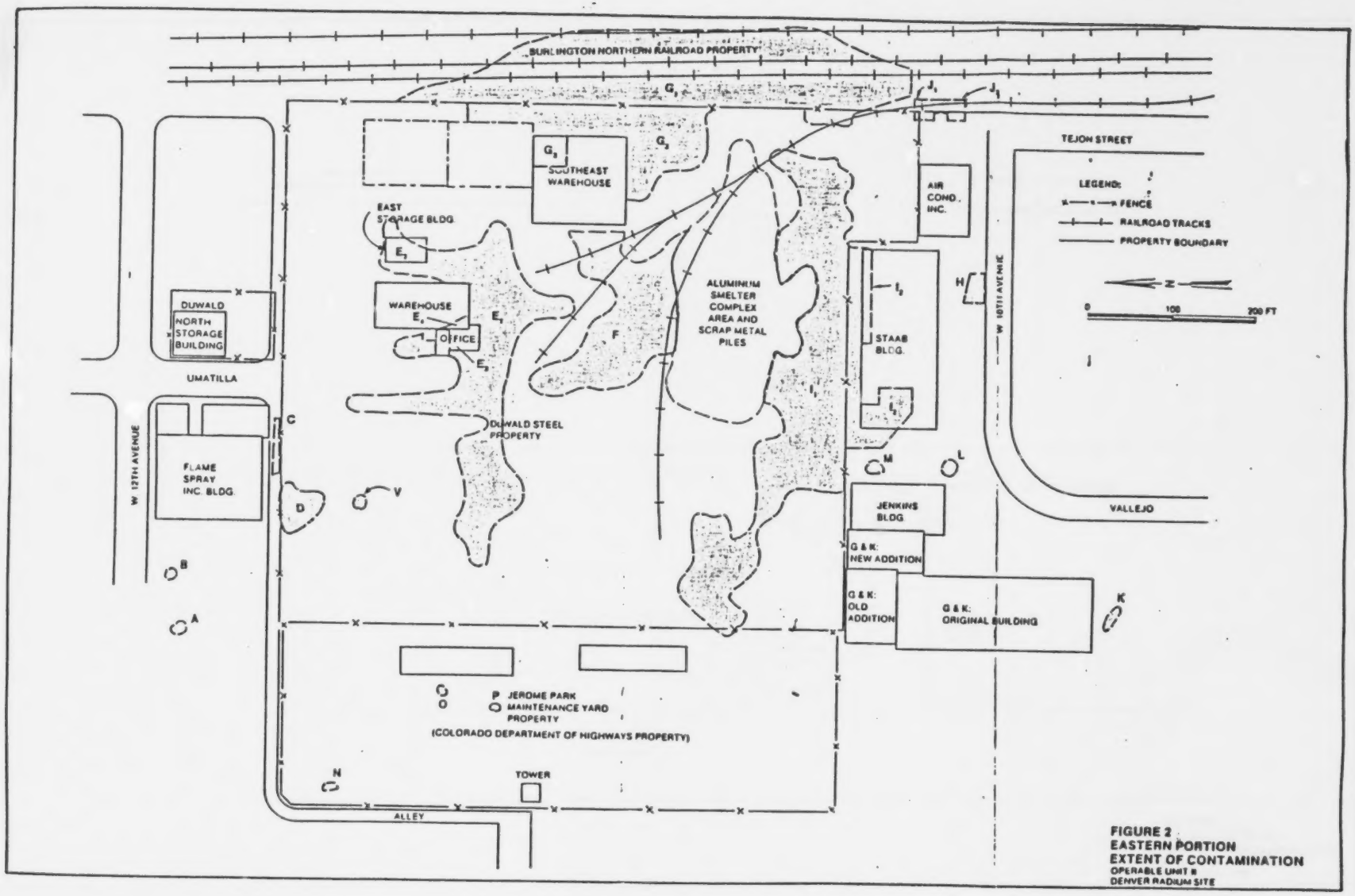

FIGURE 2
EASTERN PORTION
EXTENT OF CONTAMINATION
OPERABLE UNIT II
DENVER RADIUM SITE

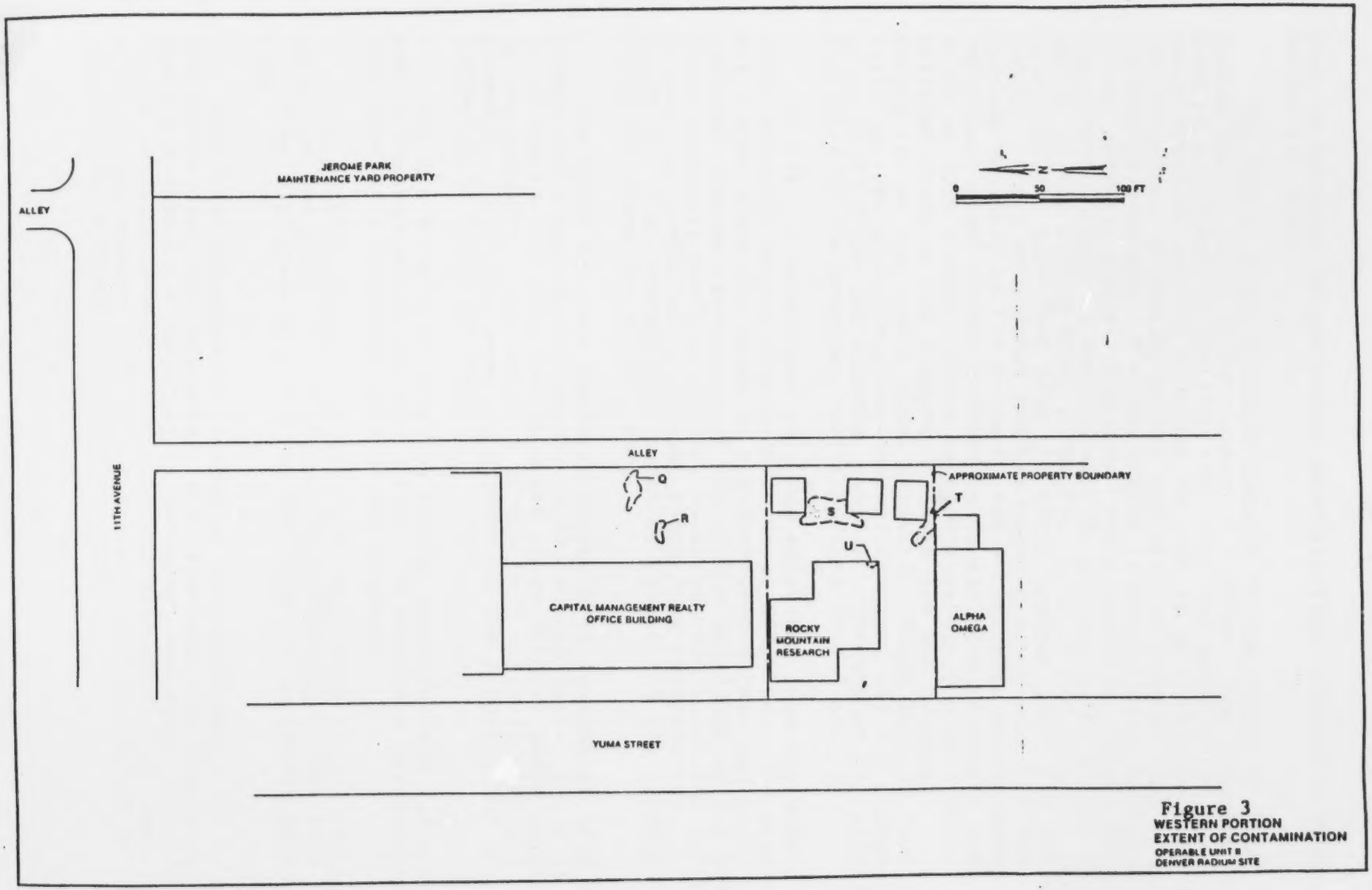

Figure 3
WESTERN PORTION
EXTENT OF CONTAMINATION
OPERABLE UNIT II
DENVER RADIUM SITE

area is typified by low annual precipitation, averaging about 14 inches per year.

The DuWald Steel property located on the corner of 11th Avenue and Umatilla Street covers 10.5 acres. The property is used as a commercial facility that buys and sells scrap metal. Scrap metal is stacked in piles as high as 40 feet over much of the property. A portion of the property is covered with reinforced concrete. The topography is fairly level with a slight westerly slope. Two major water conduits, Denver Water Department Conduit 12 and Conduit 18, run east-west across the center of the DuWald Steel property. Both of the conduits are approximately five feet deep and carry treated water for water supply. There is another conduit running north-south on the eastern boundary of the property and a 100-foot, Denver Water Department right-of-way located on Duwald Steel property just south of 12th Avenue. There is approximately 0.3 mile of railroad track on the property. There are six permanent structures on the DuWald Steel property. These include four buildings, an aluminum scrap smelter complex, and one permanent scrap metal crane and shredder complex. The number of full-time employees on the premises varies between 35 and 40.

In 1982, contaminated soil was excavated from the DuWald Steel property during construction of an addition. The material was placed along the fence in the southwest corner and then regraded. During remodeling of one of the buildings on the DuWald Steel property, subfloor venting measures were taken and a vapor barrier was installed to prevent radon from entering the building. The Colorado Department of Health and EPA jointly performed oversight of this work.

The Rocky Mountain Research property is located at 1020 Yuma Street and covers approximately 13,200 square feet. There is a 3,160 square-foot main building and three storage sheds located on the property. The majority of the open space is concrete pavement. Four employees are present on the property for an estimated 40 hours per week.

The G & K Services property covers approximately 1.4 acres and is located at 999 Vallejo Street. A one-story building with two, two-story additions sits on the property.

The Jenkins property at 2177-2191 West 10th Avenue covers less than one acre. A one-story office building houses four full-time employees 40 hours per week and two employees part-time.

The Staab property is located at 2121-2125 West 10th Avenue and covers less than one acre. Approximately nine people work 40 hours per week in a one-story cinder block building. The floor of the building is a six-inch concrete slab about four feet above grade on the western side of the building and decreasing to about one foot above grade on the eastern side.

Located at 1001 Tejon Street is the Air Conditioning, Inc., property which covers less than one acre. A one-story building is occupied by four full-time workers.

The Jerome Park Maintenance Yard at 2300 West 11th Avenue covers approximately three acres and is owned by the Colorado Department of Highways. Located on the property are two vehicle and equipment storage buildings and a small two-story building. On the south end of the property is a dome-shaped structure which is used to store sand. There are several piles of sand, dirt, and gravel situated throughout the property. An estimated 20 workers are on the property 40 hours per week, except during storm conditions when the property is occupied around the clock.

The Burlington Northern Railroad property is 2.2 acres of active railroad. This property is between 10th and 12th Avenues to the east of the DuWald Steel property. A spur of the railroad extends onto the Duwald Steel property.

The Capital Management Realty property at 1050 Yuma Street covers less than one acre. The only structure on the property is an office building with a finished garden level basement. The building is presently unoccupied.

At 1010 Yuma Street is the Alpha Omega Electronics property. This property is less than one acre in size. A one-story office and a storage building are the only structures on the property. The office houses nine employees 40 hours per week. Most of the ground surrounding the buildings is covered with concrete walkways and an asphalt pavement.

Current Site Status

Radium and its associated decay products are the primary contaminants of concern at the 11th and Umatilla properties. Since gamma radiation readings in excess of background may indicate the presence of radium, a gamma radiation survey was used to outline the extent of possible radium contamination on the 11th and Umatilla properties (Shaded areas of Figures 2 and 3). Gamma radiation readings in excess of background were found over 170,436 square feet of the properties including in several buildings. Average gamma radiation measurements ranged from 0.6 microroentgen per hour (µR/hr) to 94 µR/hr above background. The maximum gamma radiation measurement was 611 µR/hr above background. Elevated gamma radiation readings were found over 11 square feet of the roof in the Rocky Mountain Research building. The average and maximum gamma radiation measurements in this area were 12 µR/hr and 17 µR/hr, respectively. (A general discussion of radiation and its associated units of measurement is presented in Appendix A of the Operable Unit II FS and in the Public Health and Environmental Assessment, Appendix B of the Operable Unit II FS.)

The presence of radium in the soil and underneath the buildings was verified by radiochemical analysis of subsurface soil samples. The average radium concentration in the contaminated soils on the 11th and Umatilla properties ranged from 3.2 picocuries per gram (pCi/g) to 931 pCi/g. The maximum radium concentration found on the properties was 931 pCi/g. The maximum depth of radium contamination found on the properties was 120 inches. The estimated total volume of radium contaminated soil on the 11th and Umatilla properties is 15,400 cubic yards of which 1,000 cubic yards lie under structures. Table 1 summarizes the gamma radiation and radium concentration data collected on the 11th and Umatilla properties.

Radon decay product contamination on the 11th and Umatilla properties exists in the Duwald Steel office building and the basement of the Capital Management Realty building. During a 1985 EPA investigation, a maximum radon decay product concentration of 0.030 working level (WL) was detected in the southwest and northwest areas of the DuWald Steel office building. Concentrations up to 0.304 WL were detected in the northeast area of the basement of the Capital Management Realty building. These levels exceed the limit of 0.02 WL allowed by EPA standards for radon. An emergency response action was not taken at the DuWald Steel office building because the patterns of occupancy and the concentrations of radon decay products present during periods of occupancy reduce the likelihood of significant long-term exposure. No emergency response action was taken at the Capital Management Realty building because the building was and is presently unoccupied. The complete set of radon decay product concentration data collected for the 11th and Umatilla properties is presented in Table 2-2 in the Operable Unit II FS.

Fixed and removable alpha radioactivity sampling was conducted in all of the buildings on the DuWald Steel property and the Rocky Mountain Research property. No alpha radioactivity measurements were found which exceeded the Colorado Department of Health guidelines for alpha radioactivity.

The radium concentration in the soils on the 11th and Umatilla properties and the radon decay product concentrations and gamma radiation levels found in certain buildings exceed the "EPA Standards for Remedial Actions at Inactive Uranium Processing Sites," 40 CFR Part 192, which EPA has determined are relevant and appropriate Federal requirements for the 11th and Umatilla properties. These standards are discussed later in this summary in the section entitled "Statutory Determinations".

The elevated concentration of radium and the uncontrolled state of the soils at the 11th and Umatilla properties pose a health hazard due to three principal potential exposure pathways. In order of decreasing significance, they are: (1) inhalation of radon gas, the immediate decay product of radium, and radon's own short-lived decay products, (2) direct gamma radiation exposure from the decay of radium and its progeny, and (3) ingestion or inhalation of radium-contaminated materials. Since radium is in

Table 1
SURFACE AND SUBSURFACE CONTAMINATION
OPERABLE UNIT II, DENVER RADIUM SITE

Location	Volume (yd^3)	Area (ft^2)	Gamma (μR/hr) Average	Gamma (μR/hr) Maximum	Depth[a] (in.)	Radium Concentration (pCi/g) Average	Radium Concentration (pCi/g) Maximum
Area A	3.7	100	9	9	12	9	15.0
Area B	1.1	30	4	5	12	NA	NA
Area C	13	350	9	13	12	4.6	5.7
Area D	129	2,610	14	19	16	NA	NA
Area E_1	3,481	27,510	22	73	Range from 22 to 68 Avg: 41	64	111
Area E_2	124	1,344	5	8	30	17	17
Area E_3	209	1,536	19	29	44	NA	NA
Area E_4	10	72	18	19	44	NA	NA
Area F	3,010	14,778	47	197	66	65	65
Area G_1	2,571	53,392	79	191	Range from 6 to 56 Avg: 15.6	79.7	690
Area G_2	259	1,500	15	51	56	NA	NA
Area G_3	908	13,373	59	191	Range from 14 to 52 Avg: 22	931	931
Area H	232	690	5	8	109	156.0	409.5
Area I_1	3,646	43,680	28	471	Range from 14 to 84 Avg: 27	71.1	311.7
Area I_2	661[b]	5,100	7	10	24 and 30 at 78 - 120	125.8	176.5
Area J_1	39	1,040	15	33	12	27.3	105
Area J_2	6	300	6	7	6	6.5	8.5
Area K	11[b]	300	2	3	12	40.7	354
Area L	14[b]	750	5	6	6 at 42 to 48	16.1	16.1
Area M	14[b]	750	6	7	6 at 84 to 90	22.4	22.4
Area N	11	300	5	7	9	15.3	98.9
Area O	1.4[b]	75	5	5	6	3.2	3.7
Area P	0.9[b]	50	2	2	6 at 36	8.7	54.7
Area Q	7.5	163	9	22	15	51	215.9
Area R	4.2	75	7	8	18	156.8	660
Area S	22	409	90	611	Range of 12 to 22 Avg: 17	NA	NA
Area T	4.4	118	94	174	12	NA	NA
Area U	0.2	11	12	17	6	NA	NA
Area V	4.1	30	0.6	0.6	44	44	44
Total	15,398 (15,397 soil; <1 debris)[c]	170,436 (170,425 soil; 11 debris)			Maximum Depth: 120		

[a] Depth indicates the estimated depth of contamination. A range indicates a variation in the depth of contamination.

[b] Volume does not include clean overburden.

[c] Debris is material from RMR building.

Notes: Maximum gamma is maximum grid scan gamma. Gamma readings are net corrected readings above background.

NA = Data not available or not recorded for this area.

a form that is relatively insoluble, and since migration of radiological contaminants into the ground water has not been found, ingestion or contact with contaminated ground water is not among the principal potential exposure pathways. Since there is no surface water onsite, ingestion or contact with contaminated surface water is also not among the principal potential exposure pathways. Each of the three principal exposure routes resulting from the radium contamination on the 11th and Umatilla properties will be discussed briefly in terms of the potential health risks associated with that exposure route.

Inhalation of Radon Decay Products:

Radon gas and its decay products present the greatest health risk from long-term exposure. Radon gas decays to a series of short-lived particulates which are typically electrostatically charged at their formation and often attach themselves to airborne particles. If these contaminated particles are inhaled, then the lungs and other internal organs are exposed to the highly ionizing sub-atomic particles which the radon decay products emit. Prolonged inhalation of air with a high concentration of radon decay products has been conclusively shown to increase the risk of contracting lung cancer in uranium miners.

Dispersion quickly dilutes radon emanating from radium-contaminated ground. This mechanism will minimize the radon concentration in the air above the open areas of the 11th and Umatilla properties to such an extent that no one working on or living near the properties is presently at risk from exposure to radon and its associated decay products from this source. Radon decay products can concentrate to unacceptable levels in buildings built over contaminated ground if those buildings are energy efficient and well-sealed, that is, have little exchange of indoor air with outdoor air. The DuWald Steel office building and the basement of the Capital Management Realty building exhibit concentrations of radon decay products exceeding the relevant and appropriate EPA standard. The current risks associated with the elevated radon decay product concentrations in the DuWald Steel office building are believed to be small compared with possible future risks for the following reasons. First, the buildings are forced-air ventilated. Second, the duration of exposure is limited due to the fact that people work there rather than live there. Finally, during the times that people are working there, radon levels, and consequently exposures to radon, are reduced because the air exchange rate with the outdoors increases when people are entering and leaving the building. No current risk associated with the elevated radon decay product concentration exists in the basement of the Capital Management Realty building because the area is presently unoccupied.

Although the present public health risk from radon decay product exposure at the 11th and Umatilla properties is comparatively minor for the reasons stated above, EPA has

determined that a significant increase in public health risk would occur if (1) any of the contaminated material on the properties is spread closer to potential receptors, especially if it is used as fill or construction material, or (2) if any of the buildings on the 11th and Umatilla properties are sealed to make them more airtight, or (3) if changes in existing occupancy or use occur, or (4) if the properties are ever redeveloped for any use that involves occupancy in enclosed, energy-efficient structures. The Public Health and Environmental Assessment for the 11th and Umatilla properties, summarized below and contained in Appendix B of the Operable Unit II FS, presents projected cancer risks if EPA were to take no action at the properties and the properties were redeveloped in any of these ways.

If a building were constructed over Area G, the largest contaminated area on the 11th and Umatilla properties, representing about 17% of the estimated total volume of contamination on the properties, and several conservative assumptions are made (such as lifetime exposure), the estimated radon decay product concentration in the building would average 0.35 WL with an estimated maximum concentration of 4.14 WL. The radon decay product concentration in a typical United States home is 0.005 WL and the relevant and appropriate EPA standard, 40 CFR Part 192, is 0.02 WL. The average projected cancer risk (excluding background) to individuals working in such a building ranges from 380 to 1,400 cancer deaths per 10,000 persons exposed. The average projected cancer risk to individuals living in such a building ranges from 1,900 to 5,000 cancer deaths per 10,000 persons exposed.

These risk values can be compared to the average projected cancer risk if the radon decay product concentration in the building was 0.02 WL, the EPA standard. In this case, the average projected cancer risk to individuals working in such a building ranges from 23 to 91 cancer deaths per 10,000 persons exposed. The average projected cancer risk to individuals living in such a building ranges from 130 to 500 cancer deaths per 10,000 persons exposed. If the radon decay product concentration in the building was that of a typical United States home, 0.005 WL, then the average projected cancer risk to individuals living in the building would range from 33 to 130 cancer deaths per 10,000 persons exposed. It should be noted that these average projected cancer risk numbers do not include the EPA-estimated spontaneous risk of lung cancer, that is, the risk not attributable to either smoking or radon. Table 2 presents the information stated above.

Gamma Radiation Exposure:

The radioactive decay of radium and its decay products results in the emission of highly penetrating gamma radiation. Gamma radiation is of concern because it can easily penetrate a few centimeters of soil to give anyone standing over a contaminated area a reasonably uniform irradiation over the whole body. The greater the duration or intensity of this exposure,

Table 2
PROJECTED CANCER RISKS
OPERABLE UNIT II
DENVER RADIUM SITE

Scenario	Average Exposure	Average Cancer Deaths Per 10,000 Persons Exposed	
Radon Decay Products:			
Building constructed over Area G	0.35 WL	Workplace	380 to 1400
		Residential	1900 to 5000
EPA Standard*	0.02 WL	Workplace	23 to 91
		Residential	130 to 500
Typical U.S. Home	0.005 WL	Residential	33 to 130
Gamma Radiation:			
Building constructed over Area G	159 μR/hr	Workplace	40**
		Residential	130**
EPA Standard*	20 μR/hr	Workplace	31**
		Residential	53**
Background	15 μR/hr	Residential	27

* 40 CFR Part 192
** In addition to risk from exposure to background gamma radiation levels.

the larger the dose, and hence the greater the risk of adverse health effects. In the case of the 11th and Umatilla properties, the gamma radiation emission is limited to the area immediately above the contamination.

As discussed previously, EPA has determined that a significant increase in public health risk would result if any of the contaminated material on the 11th and Umatilla properties was disturbed and misused or if the area was redeveloped. If a building was constructed over Area G, the largest area of contamination on the 11th and Umatilla properties, the estimated annual dose to a person working in the building would average 159 millirem per year (mrem/yr) with an estimated maximum annual dose of 384 mrem/yr. The estimated annual dose to a person living in a building built over Area G would average 519 mrem/yr with an estimated maximum annual dose of 1,255 mrem/yr. These doses are in addition to the background dose of 130 mrem/yr incurred by those living in the Denver area and resulting from cosmic, terrestrial, and internal sources. The National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP) recommend a maximum allowable whole-body gamma radiation dose of 100 mrem/yr for members of the public in addition to natural background radiation and medical exposures they receive.

The projected cancer risk from gamma radiation (including background) to individuals working in a building built over Area G would average 44 cancer deaths per 10,000 persons exposed. The projected cancer risk to individuals living in the building would average 130 cancer deaths per 10,000 persons exposed. If individuals in any building were to receive a lifetime gamma radiation dose equivalent to that of the relevant and appropriate EPA standard, 40 CFR Part 192, then the projected cancer risk to those working in the building would average 31 cancer deaths per 10,000 persons exposed and the projected cancer risk to those living in the building would average 53 cancer deaths per 10,000 persons exposed. The average projected cancer risk to individuals receiving a lifetime dose resulting from the Denver area background would be 27 cancer deaths per 10,000 persons exposed. It should be noted that cancer risks resulting from gamma radiation exposure are in addition to those resulting from inhalation of radon decay products. Table 2 presents the information stated above.

Inhalation or Ingestion of Radiologically Contaminated Material:

Inhalation of the long-lived radionuclides like uranium, thorium, and radium is possible for persons living or working on or near the 11th and Umatilla properties. Airborne particulate matter may contain small concentrations of these radionuclides resulting in a potential human exposure pathway. Inhalation or direct ingestion of long-lived radionuclides can result in significant doses to various internal organs of the body. However, studies by the United States Department of Energy have shown that the projected radiation doses from this source are

many times smaller than those estimated for either radon decay product inhalation or direct gamma radiation exposure using even the most conservative assumptions. Also, it is unlikely that a person would ingest large amounts of the radium-contaminated material on the 11th and Umatilla properties and dust control measures ordinarily employed during excavation have been shown to provide sufficient control of exposure from this source. For these reasons, EPA acknowledges the human exposure pathway resulting from inhalation and ingestion of radionuclides, but no quantitative risk numbers were developed in the Public Health and Environmental Assessment for the 11th and Umatilla properties.

It is clear that a release or substantial threat of release of a hazardous substance or pollutant or contaminant into the environment has occurred at the 11th and Umatilla properties and the release or threat of release may present an imminent and substantial endangerment to public health. It is also clear from the calculated risks that remedial action at the 11th and Umatilla properties is justified.

Enforcement

A detailed responsible party search for the entire Denver Radium Site has been initiated. Initial investigations regarding the 11th and Umatilla properties indicate that the Schlesinger Radium Company and its successor, Radium Company of Colorado, operated a processing facility at this location from approximately 1915 to 1921, the time of apparent disposal of ore processing wastes containing, among other contaminants, radium, the hazardous substance of concern. The responsible party search has yet to trace either of these companies or any associated companies to a viable, present-day entity. At this time, the responsible party search has not revealed that the present owners of the 11th and Umatilla properties have any record of having been connected with the activities that caused the site to be contaminated with radioactivity.

EPA does not feel that response actions should be delayed pending finalization of the responsible party search. If, upon finalization of the search, responsible parties are clearly identified, EPA will formally notify them of the selected remedy for the 11th and Umatilla properties and initiate negotiations for the implementation of the remedy. If the responsible parties do not formally commit to performing the remedy in a timely manner, EPA will proceed with a Fund-financed remedial design and remedial action and will attempt to recover EPA's response costs from the responsible parties.

Community Relations History

On August 13, 1987, the Proposed Plan for the 11th and Umatilla properties was published in the Denver Post. On August 14, 1987, the Proposed Plan was published in the Rocky Mountain News. The display ads announced the August 14 through September 4, 1987, public comment period and the August 26 public meeting, gave a brief description of the remedial action alternatives, and stated the rationale for the Proposed Plan.

In addition to publishing the Proposed Plan, EPA issued a press release announcing the public comment period. The press release, along with the Executive Summary of the Operable Unit II FS, was mailed to the approximately 300 names on the EPA-compiled Denver Radium Site mailing list.

On August 7, 1987, EPA scheduled a meeting with the owners and tenants of the 11th and Umatilla properties to describe and discuss the cleanup alternatives being considered for the 11th and Umatilla properties. No owners or tenants attended the meeting.

On August 26, 1987, EPA held a public meeting concerning the 11th and Umatilla properties. Major concerns raised by those who attended the meeting were how the remedial action at the properties would affect the business operations of the owners and tenants and if the owners or tenants would be compensated for any loss of business. A second major concern raised at the public meeting was the liability of owners of contaminated properties. Another major concern raised during the public meeting was a question of why remedial action at the Site would be so costly.

In general, the public supports the complete excavation and permanent offsite disposal of all Denver Radium Site material including the contaminated material present on the 11th and Umatilla properties. The community has reservations about any temporary response action which EPA may take at the 11th and Umatilla properties because of concerns that the State of Colorado will not make available a permanent disposal site for this material and therefore, no permanent measures will ever be implemented at the 11th and Umatilla properties. The portion of the community in the vicinity of the Card Corporation property (See Figure 1) strongly opposes the alternative which envisions temporary storage at the Card Corporation property, Operable Unit X of the Denver Radium Site, again because of concerns that the State of Colorado will not make available a permanent disposal site and that the temporary storage facility on the Card Corporation property will become permanent, resulting in a decrease in property values in the area.

The Responsiveness Summary attached to the Record of Decision contains the official transcript of the public meeting, describes in more detail the nature and level of the community's concern, and includes EPA's responses to all comments received during the public review of the Operable Unit II FS.

Alternatives Evaluation

EPA evaluated potential remedial action alternatives for the 11th and Umatilla properties primarily by progressing through the series of analyses which are outlined in the National Contingency Plan (NCP), in particular, 40 CFR Section 300.68; the Interim Guidance on Superfund Selection of Remedy, December 24, 1986, (OSWER Directive No. 9355.0-19); and the Additional Interim Guidance for FY '87 Records of Decision, July 24, 1987, (OSWER Directive No. 9355.0-21). This process, in part, enables EPA to address the SARA Section 121 requirements of selecting a remedial action that is protective of human health and the environment, that is cost-effective, that attains Federal and State public health and environmental requirements that are applicable or relevant and appropriate, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Additionally, SARA Section 121 and the guidance documents referenced above require EPA to give preference to remedies which employ treatment which permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances as their principal element.

The selection of remedy process begins by identifying certain site-specific information to be assessed in determining the types of response actions that will be considered for the properties. A general list of site-specific information to be considered in the process is contained in Section 300.68(e)(2) of the NCP. This list was used to identify specific site and waste characteristics of the 11th and Umatilla properties. (See Table 5-1 of the Operable Unit II FS.) Based upon these site and waste characteristics, EPA was able to scope, from the universe of all possible response actions, a set of response actions and associated technologies to be considered for the 11th and Umatilla properties. An example of this scoping process was the elimination of onsite biological treatment from further consideration because biological processes capable of detoxifying radioactive contaminants do not exist. Appendix D of the Operable Unit II FS summarizes the scoping process and Table 5-2 of the Operable Unit II FS details the results.

Section 121(b)(1) of SARA requires that an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant be conducted. As part of this process, EPA evaluated permanent solutions to the problems associated with the specific hazardous substances present on the 11th and Umatilla properties. The alternative treatment and resource recovery technologies considered included, among others, reprocessing.

Before the technologies were assembled into remedial action alternatives, they were categorized as either source control or management-of-migration measures and then prescreened based on

their suitability to abate the threat at the 11th and Umatilla properties. Source control measures are intended to contain the hazardous substances onsite or eliminate the potential for contamination altogether by transporting the hazardous substances to a safer location. Management-of-migration actions are taken to minimize and mitigate the migration of hazardous substances. The result of the prescreening of both source control and management-of-migration measures based on their suitability to abate the threat at the 11th and Umatilla properties is presented in Table 5-3 of the Operable Unit II FS.

The next step of the selection of remedy process is assembling the remaining technologies and/or disposal options into remedial action alternatives. Pursuant to OSWER Directive No. 9355.0-19, "Interim Guidance on Superfund Selection of Remedy", remedial action alternatives are to be developed ranging from those that would eliminate the need for long-term management (including monitoring) at the site to alternatives involving treatment that would reduce toxicity, mobility, or volume as their principal element. Remedial action alternatives developed in this way will vary mainly in the degree to which they rely on long-term management of treatment residuals or low-concentration wastes. Further, a containment option involving little or no treatment and a no action alternative are to be developed. Remedial action alternatives developed in the Operable Unit II FS for the 11th and Umatilla properties were:

1. No Action

2. Deferred Removal, Offsite Permanent Disposal

3. Onsite Reprocessing/Treatment, Offsite Permanent Disposal

4. Onsite Permanent Disposal

5. Offsite Permanent Disposal

6. Onsite Temporary Land Storage, Offsite Permanent Disposal

7. Onsite Temporary Building Storage, Offsite Permanent Disposal

8. Onsite Temporary Containment (Capping), Offsite Permanent Disposal

9. Temporary Building Storage at the Card Corporation Property (OU X), Offsite Permanent Disposal

Alternatives 2, 3, 5, 6, 7, 8, and 9, since they require the permanent offsite disposal of contaminated material, would eliminate the need for long-term management (including monitoring) at the 11th and Umatilla properties. Alternative 3

involves treatment as its principal element, but does not necessarily reduce the mobility, toxicity, or volume of the waste. Alternative 4 requires a permanent onsite remedy, and hence, long-term management and monitoring at the 11th and Umatilla properties. Alternatives 4, 6, 7, and 8 are containment options - Alternative 4 requiring permanent onsite containment and Alternatives 6, 7, and 8 requiring temporary onsite containment. Finally, No Action was included as Alternative 1.

Alternative 5, Offsite Permanent Disposal, is not immediately implementable because the State of Colorado has not at this time designated a facility for the disposal of the Denver Radium Site wastes. Pursuant to CERCLA Section 104(c)(3)(C)(ii), it is the responsibility of the State to assure the availability of a disposal site. Also, in order to comply with SARA Section 104(k), and in order to assure that remedial actions within Colorado continue, the State must provide adequate assurance of the availability of a hazardous waste treatment or disposal facility within three years from the effective date of SARA, October 17, 1986. Although progress is being made to this end, the State does not expect to have a fully operational disposal facility prior to implementation of any remedial action and possibly for up to five years. In the meantime, in its presently uncontrolled state, the radium-contaminated material at the 11th and Umatilla properties could be misused or inadvertently spread, possibly increasing the risk to present or future public health or the environment. In addition, the cost of final remedial action is expected to increase due to inflation; the 11th and Umatilla property owners and tenants face economic losses associated with restricted use of their properties; and EPA may incur further cost by updating site studies in face of changing site conditions. For these reasons, EPA determined that, in order to effectively mitigate or minimize short-term threats to and provide adequate protection of public health and the environment at the 11th and Umatilla properties, developing remedial action alternatives which include temporary response actions was appropriate. Thus, Alternatives 6, 7, 8, and 9 were developed to reduce existing risks by including temporary response measures followed by permanent offsite disposal of the contaminated material when a facility for such disposal becomes available.

Initial screening, which is the next step in the selection of remedy process, narrows the list of potential remedial action alternatives. Consistent with Section 300.68(g) of the NCP and the OSWER Directive No. 9355.0-19, the remedial action alternatives developed for the 11th and Umatilla properties were initially screened using the criteria of cost, implementability (acceptable engineering practices), and effectiveness. Table 7-1 in the Operable Unit II FS summarizes the initial screening process. Alternatives 1, 2, 6, 7, and 9 passed the initial screening and were carried forward for detailed analysis while Alternatives 3, 4, 5, and 8 were screened out primarily for the reasons set forth below.

Alternative 3, Onsite Reprocessing, was eliminated from further consideration based on its lack of effectiveness. The residuals from this process, both the reprocessed soil and the concentrated precipitate resulting from the reprocessing of the soil, would require disposal in a facility that meets or exceeds the requirements of 40 CFR Part 192. These residuals would retain many of the toxicity and mobility characteristics of the untreated material and, in addition, the volume would not be significantly affected. This remedial action alternative would provide no additional benefit to public health or the environment over other remedial action alternatives to be considered. With the elimination of this remedial action alternative, no remedial action alternative which involves treatment as a principal element survives the initial screening. However, EPA has no reasonable belief that this remedial action alternative is equally protective as other remedial action alternatives, or offers the potential for better treatment performance or implementability, lesser adverse impacts, or lower costs than demonstrated remedial action alternatives.

Alternative 4, Onsite Permanent Disposal, was eliminated from further consideration because of implementability and effectiveness factors. The property would have to be permanently dedicated as a disposal site and measures would have to be taken to isolate the contaminated material from man and the environment for a thousand years without ongoing active maintenance. This objective would be difficult to attain in an urban area where there is a high potential for human disturbance and in an area where the ground water is close to the surface as it is on the 11th and Umatilla properties. This remedial action alternative would require long-term government ownership, licensing, and management and monitoring to protect the integrity of the facility. In addition, the implementation of this alternative would cause severe disruption of the business operations of the 11th and Umatilla properties, and place permanent restrictions on future land use. These requisites would conflict with current and proposed land uses for the area, as well as State policies on siting permanent disposal facilities (6 CCR 1007-1, Part III, Schedule E, Criterion 1). The State siting objectives specify, among other things, that permanent disposal facilities must be located away from populated areas and that hydrogeologic and other environmental conditions be conducive to continued immobilization and isolation of contaminants from usable ground water sources. These criteria are clearly not met at the 11th and Umatilla properties which are located within a metropolitan area, and where the depth to ground water is only 10 to 15 feet.

Alternative 5, Offsite Permanent Disposal, is not implementable at this time because the State of Colorado has yet to designate a facility for the disposal of Denver Radium Site wastes. This alternative was therefore eliminated during initial screening.

Alternative 8, Onsite Temporary Containment (Capping), Offsite Permanent Disposal, was eliminated from further

consideration because it would not be as protective of public health as other remedial action alternatives being considered and would require severe access restrictions on a large portion of the 11th and Umatilla properties to maintain the integrity of the cap. These access restrictions would be difficult to implement without forcing business operations on the properties and use of the area to cease.

The following is a description of the remedial action alternatives surviving the initial screening:

1. No Action

   If this remedial action alternative were selected, no action would be taken at the contaminated 11th and Umatilla properties. This alternative serves as a baseline and was retained for further analysis and consideration as required by Section 300.68(f)(1)(v) of the NCP.

2. Deferred Removal, Offsite Permanent Disposal

   If this remedial action alternative were selected, removal of the contaminated material at the 11th and Umatilla properties would be deferred until an approved offsite permanent disposal facility is identified and made available by the State of Colorado. Once this facility becomes available, the entire estimated 15,400 cubic yards of contaminated material on the 11th and Umatilla properties including the estimated 1,000 cubic yards of contaminated material lying beneath the DuWald Steel east storage shed, the Duwald Steel office building and attached warehouse, the DuWald Steel southeast warehouse, and the Staab building would be excavated. Special precautions would be required during the excavation of material from around the water supply conduits that are present on the properties. Excavation at the 11th and Umatilla properties would also involve the moving of metal scrap piles which are present on the DuWald Steel property. There is a concrete cap on the DuWald Steel property which rests on contaminated soil. This cap would have to be removed in order to excavate the underlying material. The contaminated material from the 11th and Umatilla properties would be transported by either truck or rail for final disposal at a permanent disposal facility. The 11th and Umatilla properties would then be available for unrestricted use.

6. Onsite Temporary Land Storage, Offsite Permanent Disposal

   If this remedial action alternative were selected, all contaminated material on the 11th and Umatilla properties, with the exception of the material lying

under the concrete cap, would be excavated as described above and temporarily stored on the site. An asphalt pad would be constructed on an open area of the properties. Contaminated material would be placed on the pad and covered with a suitable material. Security precautions, inspections, and radiation monitoring of the storage facility and concrete cap that is already present on the DuWald Steel property would be instituted. Once a suitable offsite permanent disposal facility becomes available, the entire estimated 15,400 cubic yards of contaminated material would be transported by either rail or truck to the facility. The 11th and Umatilla properties would then be available for unrestricted use.

7. Onsite Temporary Building Storage, Offsite Permanent Disposal

   If this remedial action alternative were selected, contaminated material on the 11th and Umatilla properties, with the exception of the material lying under the concrete cap, would be excavated as described above and placed in containers. The containers would be temporarily stored in an existing or newly constructed building on the properties. Security precautions, inspections, and radiation monitoring of the storage facility and concrete cap would be instituted. Once a suitable offsite permanent disposal facility becomes available, the entire estimated 15,400 cubic yards of contaminated material would be transported by either rail or truck to the facility. Upon removal of the containers, the building would be decontaminated and either dismantled or left in place. The 11th and Umatilla properties would then be available for unrestricted use.

9. Temporary Building Storage at the Card Corporation Property (OU X), Offsite Permanent Disposal

   If this remedial action alternative were selected, a portion of the contamination on the 11th and Umatilla properties would be excavated, placed in containers, and the containers transported to the Card Corporation Property (OU X) for temporary storage. The remaining material on the 11th and Umatilla properties would be temporarily stored onsite in either a land storage or building storage facility. Security precautions, inspections, and radiation monitoring of the storage facilities on both operable units would be instituted. Once a suitable offsite permanent disposal facility becomes available, the contaminated material from both operable units would be transported by either rail or truck to the facility. The 11th and Umatilla properties, as well as the Card Corporation property, would then be available for unrestricted use.

The response action for the 11 square feet of contaminated roof in the Rocky Mountain Research building is common to each of the previously discussed remedial action alternatives except for the No Action Alternative. The contaminated portion of the building's roof would be decontaminated or, if necessary, replaced. Radioactive material from the decontamination would be handled with the contaminated soils from the 11th and Umatilla properties.

Consistent with Section 300.68(h) of the NCP, the OSWER Directive No. 9355.0-19, and the OSWER Directive No. 9355.0-21, the remedial action alternatives remaining after initial screening were further refined and then subjected to detailed analysis. Detailed analysis of each remedial action alternative entailed evaluation based on the three broad criteria of implementability, effectiveness, and cost. For each of these broad criteria, EPA identified appropriate and more specific "component measures" so that the remedial action alternatives could be compared to each other using a full array of evaluation factors. The component measures derived for implementability, effectiveness, and cost were based upon specific requirements and criteria contained in Section 300.68(h)(2) of the NCP, SARA Sections 121(b)(1)(A through G), SARA Section 121(c), the discussion on detailed analysis contained in the OSWER Directive No. 9355.0-19, and the OSWER Directive No. 9355.0-21.

The component measures of implementability are: technical feasibility, constructability, reliability, administrative concerns, availability of the technology, and operation and maintenance. The component measures of effectiveness are attainment of applicable or relevant and appropriate requirements (ARARs); effectiveness in significantly and permanently reducing mobility, toxicity, and volume; persistence, toxicity, mobility, and propensity to bioaccumulate of the hazardous substances and their constituents; protectiveness/health effects; environmental protectiveness/potential for adverse environmental impacts; and compliance with the Solid Waste Disposal Act. The component measures of cost are: capital cost, operation and maintenance costs, and potential future remediation costs if the alternative fails. Section 8 of the Operable Unit II FS provides a comparative review of the remedial action alternatives based upon each of the component measures listed above.

Implementability Analysis:

All of the alternatives which were analyzed in detail are technically feasible and constructable as they rely on common earth moving and construction technologies - technologies which are both operationally reliable and readily available. Removal of materials from around the water supply conduits on the DuWald Steel property will require special precautions. Removal of material from under structures and scrap metal storage areas will be more difficult than removing material from the open areas on the properties. The necessary equipment and specialists for implementation of any of the remedial action alternatives are

readily available. Remedial action work similar to that envisioned in any of the remedial action alternatives is already being safely conducted in Grand Junction, Colorado, under the auspices of the Uranium Mill Tailings Remedial Action Project. Alternative 7, Onsite Temporary Building Storage, Offsite Permanent Disposal, and Alternative 9, Temporary Building Storage on the Card Corporation Property, Offsite Permanent Disposal, are the most difficult remedial action alternatives to implement because of the limited space on the 11th and Umatilla properties where a building could be constructed and because of the limited capacity of existing buildings on the properties.

No Action and Alternative 2, Deferred Removal, Offsite Permanent Disposal, are administratively the easiest alternatives to implement. The need to coordinate and obtain access agreements with the 11th and Umatilla property owners and the need to obtain necessary approvals and non-environmental construction permits from other offices and agencies are administrative implementation constraints common to all of the remedial action alternatives with the exception of No Action. Alternative 9 has an additional administrative implementation constraint, that is, an agreement with the Mentor Corporation, current owner of the Card Corporation property, to allow for storage of other Denver Radium Site wastes on the property must be finalized.

All remedial action alternatives except No Action and Alternative 2 require a limited degree of maintenance activities. The final response action associated with the remedial action alternatives, permanent offsite disposal, cannot be implemented until the State of Colorado provides a facility suitable for the disposal of this material. This implementation constraint is common to all of the remedial action alternatives except No Action.

Effectiveness Analysis:

Alternatives 6, 7, and 9 are protective remedial action alternatives which will meet contaminant-specific ARARs for radium levels in site soils and gamma radiation levels and radon decay product concentration in the DuWald Steel office building and Capital Management Realty basement once the temporary response actions are completed. In addition, these three remedial action alternatives will meet all identified action-specific and location-specific ARARs and other guidance to be considered. Alternative 2 will provide no short-term protection of public health and the environment and will meet the contaminant-specific ARARs only after the contaminated material is removed to the permanent disposal facility. No Action will provide neither short-term nor long-term protection of public health and the environment and will not meet the contaminant-specific ARARs and the possible resulting exposure would result in unacceptable risks to public health.

No Action and, in the interim, Alternative 2 will not reduce the mobility, toxicity, or volume of the contaminated material on the properties. Although Alternatives 6, 7, and 9 will not reduce the toxicity or volume of the radioactive waste, they transfer the contaminants from the uncontrolled status to a controlled facility, thereby reducing mobility. In addition, an increase in volume is often the result of the contaminated material being disturbed. Thus, Alternatives 6, 7, and 9, since they reduce the chances of the material being disturbed, also may prevent the volume of contamination from increasing.

EPA conducted a Public Health Evaluation of Remedial Alternatives to determine the short-term potential for adverse health effects from human exposure associated with the various remedial action alternatives. This analysis, summarized in Appendix F of the Operable Unit II FS, revealed that all of the alternatives considered except No Action would result in nearly equivalent exposures during implementation of the remedy. All estimated exposures are well below target levels established in ARARs. EPA also conducted a Public Health and Environmental Assessment to determine the long-term potential for adverse health effects associated with the contaminant levels present on the 11th and Umatilla properties. This analysis, summarized earlier in this summary and contained in Appendix C of the Operable Unit II FS, showed that there would be a significant increase in public health risk if the No Action alternative was implemented at the 1000 West Louisiana properties.

The potential for adverse environmental impacts at the 11th and Umatilla properties is low. However, leaving the material onsite in an uncontrolled state provides an opportunity for potential environmental impacts during a catastrophic event, such as a flood or a water main break, resulting in a substantial dispersal of the contaminants.

Cost Analysis:

No Action is the least costly alternative followed by Alternative 2. Alternative 9 is the most expensive alternative followed by Alternative 7. Alternative 6 has a mid-range cost. Table 3 presents a breakdown of each alternative's cost based upon the component measures of cost described above. An even more detailed breakdown of each alternative's cost is provided in Appendix H of the Operable Unit II FS. Section 8 of the Operable Unit II FS contains a sensitivity analysis of these costs.

In summary, the selected remedy for the 11th and Umatilla properties was chosen from the detailed analysis of remedial action alternatives. The analysis was based upon component measures of implementability, effectiveness, and cost. Table 4 outlines the detailed analysis of remedial action alternatives. (See also Section 9 of the Operable Unit II FS.)

Table 3

COST EVALUATION OF ALTERNATIVES
OPERABLE UNIT II, DENVER RADIUM SITE

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Deferred Removal, Offsite Permanent Disposal	Alternative 6 Onsite Temporary Land Storage, Offsite Permanent Disposal	Alternative 7 Onsite Temporary Building Storage, Offsite Permanent Disposal	Alternative 9 Temporary Building Storage on OU I/ Offsite Permanent Disposal	Common Elements (PIR Roof)
Capital Costs						Cost of common elements included in costs for soil alternatives.
o Initial	Not applicable	$ 50,300	$1,900,700	$3,125,500	$3,195,900	
o Deferred	Not applicable	2,285,700	2,135,400	2,095,900	2,355,300	
Operation and Maintenance						
o Short-term (up to 5 yr)	Not applicable	45,000	163,700	662,400	677,300	
o 5-yr site review	Not applicable	31,000	31,000	31,000	31,000	
Present-Worth Alternative Cost	Not applicable	2,412,000	4,230,300	5,914,800	6,153,600	
Potential Future Remediation Costs if Alternative Fails	Not applicable	Maximum cost equals initial capital cost	Maximum cost equals initial capital cost	Maximum cost equals initial capital cost	Maximum cost equals initial capital cost	Not applicable

Table 4

SUMMARY OF ALTERNATIVE EVALUATION
OPERABLE UNIT II, DENVER RADIUM SITE

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Deferred Removal/Permanent Offsite Disposal	Alternative 6 Onsite Temporary Land Storage/ Permanent Offsite Disposal
Implementability	Feasible	Additional buildings could be built over contaminated areas. Contaminated materials could be dispersed or diluted such that they would no longer be identifiable. Excavation cannot proceed until an offsite disposal facility is available. Assurance of availability required by SARA 104(k). Facility is assumed not to be available until 1992.	Temporary storage can have technical problems, such as ripping of the synthetic cover or cracks in the asphalt pad. Temporary storage would be used until offsite disposal facility is available. Availability required by SARA 104(k). Facility is assumed not to be available until 1992. Site access restrictions and approvals would be needed to construct the asphalt pad storage unit. Storage facility would severely restrict usage of overall site for 5 years, since it would occupy a large percentage of open space at one of the properties.
Effectiveness	40 CFR 192 conditions for radium-226 in soils would not be attained. Protectiveness levels for radon and gamma radiation would not be attained. These exposures could be increased if uncontrolled land use changes occur. No Action does not reduce mobility, toxicity, and volume of OU II radioactive materials. Radium is not very mobile and gives off radon decay products to the atmosphere. While not very soluble after reprocessing, radium is subject to dispersal via human activity. Radon decay products can accumulate in human lungs and are carcinogenic. Gamma radiation could cause cancer or genetic defects.	While removal is deferred, Radium-226 levels in soil would not be met. Action-specific ARAR's will be met during removal. During deferred removal, site workers would be exposed to approximately 11 mrem/yr. During excavation, remedial action workers would be exposed to approximately 75 mrem/yr (whole body Dose Equivalent), which is below the 10 CFR 20 standard of 500 mrem/yr for workers. Onsite workers who are not associated with cleanup would be exposed to approximately 2 mrem/yr, which is below the NCRP/ICRP guidance of 100 mrem/yr for chronic exposure to the general public. Transportation of 350 miles to offsite disposal facility would involve driver exposure of 6.4 mrem/trip. Minimal exposure would occur to general public during transportation, unless an accidental spill occurred, which would result in a minor increase in exposures.	During temporary storage, site workers would be exposed to approximately 11 mrem/yr. During excavation, remedial action workers would be exposed to 87 mrem/yr (whole body dose equivalent), which is below the 10 CFR 20 standard. Onsite workers not associated with cleanup would be exposed to 3 mrem/yr, which is below the NCRP/ICRP guideline. Transportation exposure would be identical to Alternative 2.
Costs	Not applicable.	Capital PW[a]--$2,336,000 O&M[b] PW--$76,000	Capital PW[a]--$4,035,600 O&M[b] PW--$194,700

Table 4

(continued)

Evaluation Criteria	Alternative 7 Onsite Temporary Building Storage Permanent Offsite Disposal	Alternative 9 Temporary Building Storage at OU X/Offsite Permanent Disposal	Common Element RMR Roof
Implementability	Containers could rip and spill material in the building. However, the building should contain any spilled materials. Temporary storage would be used until offsite disposal facility is available. Assurance of availability required by SARA 104(k). Facility is assumed not to be available until 1992. Site access restrictions and approvals would be needed to construct the asphalt pad storage unit. Storage facility would severely restrict usage of overall site for 5 years, since it would occupy a large percentage of open space at one of the properties.	Implementability considerations as described for Alternatives 6 and 7 apply at OU X for this alternative. Temporary storage would be used until offsite disposal facility is available. Availability required by SARA 104(k). Facility is assumed not to be available until 1992. Volume of waste would be transferred from the OU II properties to the OU X property.	Minimal potential for poor decontamination performance, since roof could always be completely removed. Risk of failure during removal is minimal.
Effectiveness	Radium-226 standards in soils would be met upon initial removal. Gamma radiation and radon decay product standards may also be met after removal. During temporary storage, site workers would be exposed to approximately 10 mrem/yr. During excavation, remedial action workers would be exposed to approximately 87 mrem/yr (whole body Dose Equivalent which is below the 10 CFR 20 standard. Onsite workers who are not associated with cleanup would be exposed to 3 mrem/yr, which is below the NCRP/ICRP guideline. Transportation exposures would be identical to Alternative 2. Removal and temporary container storage will not at a 10 percent discount factor. The mobility of the material would be decreased unless the container broke; however, the use of a building for storing the containers would contain any spillage.	Effectiveness considerations as described for Alternatives 6 and 7 apply at OU X for this alternative. Consolidation of some OU II property wastes with OU X property wastes would provide increased overall protection of the environment. During excavation, remedial action workers would be exposed to approximately 103 mrem/yr of whole body Dose Equivalent, which is below the 10 CFR 20 standard of 500 mrem/yr. Onsite workers who are not associated with cleanup would be exposed to 4 mrem/yr, which is below the NCRP/ICRP guideline of 100 mrem/yr. Transportation of 350 miles to offsite disposal facility would involve driver exposure of 6.4 mrem/trip. Minimal exposure would occur to general public during transportation, unless an accidental spill occurred.	Removal of radioactive materials in the roof will not reduce its toxicity, mobility, and volume; the material will be transferred from the building to either a temporary storage facility or an offsite disposal facility.
Costs	Capital PW--$5,221,400 O&M PW--$693,400	PW--$5,414,300 O&M PW--$739,300	Included in Alternative Estimates.

[a] PW = present worth at a 10 percent discount factor.
[b] O&M = Operations and Maintenance.

Selected Remedy

This Record of Decision addresses the contamination present on the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site. This is the sixth operable unit of the Denver Radium Site for which EPA has selected a remedy. EPA is undertaking additional feasibility studies to evaluate remedial action alternatives at the other Denver Radium Site operable units and will complete a Record of Decision or an Action Memorandum for each of the operable units for which a remedy has not already been selected. EPA's preferred remedial action alternative for the 11th and Umatilla properties is Alternative 5, Offsite Permanent Disposal. This alternative, however, was eliminated during the initial screening of remedial action alternatives because, until the State of Colorado provides a permanent disposal site for material from the 11th and Umatilla properties, this alternative cannot be implemented. EPA has therefore determined that the appropriate extent of remedy at the 11th and Umatilla properties is Alternative 6, Onsite Temporary Land Storage, Offsite Permanent Disposal. The State of Colorado has been consulted and concurs with the selected remedy.

Remedial Design for Operable Unit II will include the selected remedy, Alternative 6, and EPA's preferred remedial action alternative, Alternative 5, Offsite Permanent Disposal. Should the State of Colorado fulfill its obligation to assure the availability of a suitable disposal facility for material from the Denver Radium Site by the time EPA has concluded Remedial Design for the 11th and Umatilla properties, EPA may implement its preferred alternative, Offsite Permanent Disposal.

Description of the Selected Remedy:

The selected remedy consists of (1) implementing two temporary source control response actions, (2) maintaining one temporary management-of-migration response action which is already in place, and (3) implementing one final and permanent source control response action when possible.

The temporary source control response actions consist of decontaminating the 11 square feet of roof of the Rocky Mountain Research building and excavating the majority of the estimated 15,400 cubic yards of contaminated material on the properties and placing the material in a temporary land-storage facility. The implementation of these response actions will entail the construction of a large asphalt pad on the 11th and Umatilla properties. Contaminated material will be placed on this pad to a height of 10 to 15 feet and covered with a suitable liner. The temporary land-storage facility will limit the spread of contaminated material by wind and water erosion and human activity. The facility will also provide temporary protection of human health by reducing direct exposure to gamma radiation and by reducing the risk of inhalation or ingestion of contaminated soil. In addition, with the removal of contaminated material from under the buildings, radon decay product levels in those

buildings should decrease. Excavation of the contaminated material and its placement in the temporary land-storage facility could take four to eight months. Once in place, the land-storage facility will be routinely inspected and access restrictions will be instituted to maintain the integrity of the facility. The contaminated material will remain in the temporary land-storage facility until a permanent offsite disposal facility becomes available.

The temporary management-of-migration response action consists of maintaining a six-inch thick, reinforced concrete cap that already covers contaminated material on the northern portion of the DuWald Steel property. This cap, which was constructed by the property owner, will continue to limit the spread of contamination, and also provides temporary protection of human health by reducing the direct exposure to gamma radiation and the risk of inhalation or ingestion of radionuclides. The concrete cap will remain in place until a permanent offsite disposal facility becomes available.

The final and permanent source control response action will occur once a permanent offsite disposal facility becomes available and consists of removing the material in the temporary land-storage facility as well as the contamination beneath the concrete cap. This material and any portion of the cap or asphalt pad which is contaminated would then be transported by either truck or rail to the permanent offsite disposal facility. Removal of contaminated material from the land-storage facility and from under the concrete cap and transportation of this material to the permanent offsite disposal facility could take three to six months. A more detailed implementation schedule for this response action and the ones described above will be developed during Remedial Design.

The present-worth cost of the selected remedy is $4,230,300 based upon a ten-percent interest rate, a five-year discount period, and a perpetual monitoring period. The cost of this alternative includes construction of a temporary land-storage facility for the contaminated material, excavation of the material from the open areas and from under the buildings, decontaminating the roof of the Rocky Mountain Research building, placement of the contaminated material into the temporary storage facility, and maintenance and monitoring of the temporary land-storage facility and concrete cap for a period of five years. The cost of this alternative also includes removal and transport of all contaminated material, including the material beneath the concrete cap, to the offsite permanent disposal facility, decontaminating and, if necessary, dismantling the temporary land-storage facility and transporting the uncontaminated material (asphalt and liner) to a solid waste landfill.

Operation and maintenance activities will be required to ensure the effectiveness of the temporary response actions. These activities include site inspections, ongoing radiological monitoring, and possible minor repairs to the concrete cap

already in place on the DuWald Steel property or the temporary land-storage facility to be constructed on the 11th and Umatilla properties. Also included as an operation and maintenance activity for cost estimating purposes is a review of the properties which, pursuant to SARA Section 121(c), must be conducted no less than every five years if a remedial action is selected that results in any hazardous substances remaining onsite. Since EPA does not anticipate that any hazardous substances will remain onsite longer than five years, the cost of this review is considered a contingency. The maximum total of the discounted annual operation and maintenance costs of these activities using a five-year discount period and a ten-percent discount rate is $194,700. This operation and maintenance cost is included with the present-worth total alternative cost mentioned above.

Statutory Determinations:

Protectiveness: The Public Health and Environmental Assessment for the 11th and Umatilla properties summarized earlier in this document clearly shows that there would be a significant increase in the risk of contracting lung and other cancers if Alternative 1, No Action, was selected for this operable unit of the Denver Radium Site and the properties were ever developed in a way which might reasonably be expected. The only effective way to reduce this risk is excavation to achieve target residual levels established in contaminant-specific ARARs and removal of the contaminated material from the 11th and Umatilla properties to an offsite permanent disposal facility. Further, because the offsite permanent disposal facility would be designed to isolate the contaminated material from man and the environment for a thousand years, the selected remedy would provide long-term protectiveness. The temporary measures envisioned in the selected remedy will provide the necessary short-term protectiveness.

In addition to preparing the Public Health and Environmental Assessment mentioned above, EPA conducted a Public Health Evaluation of Remedial Alternatives, summarized in Appendix F of the Operable Unit II FS. For this evaluation, exposures to gamma radiation, inhalation of contaminated soils, and inhalation of radon decay products were estimated for persons who might be exposed to hazards during implementation of each alternative undergoing detailed analysis. These persons include onsite remedial action workers, individuals not associated with remedial activities but working in an onsite office, residents of a home located outside of the property boundary, a transportation worker, and an onlooker present during truck transportation of the contaminated materials. Exposures were calculated for each remedial action alternative undergoing detailed analysis. The evaluation revealed that none of the estimated exposures for any scenario of any remedial action alternative, including the selected remedy, exceeded exposure limits set by the relevant and appropriate standards or guidelines. Also, for any given scenario, there was no appreciable difference among the estimated

exposures for the remedial action alternatives. The risks associated with this type of remedial action work lie not with possible radiological exposure, but with the inherent dangers associated with general construction work. Based upon statistics from the construction industry, EPA estimates that the number of non-fatal injuries to cleanup workers would range from 0.239 to 0.473 for the type of work to be conducted during remedial action at the 11th and Umatilla properties; the number of fatalities would range from 0.025 to 0.050. (See report entitled Operable Unit II, Public Health and Environmental Assessment, Dose Commitments.) These numbers can be significantly reduced by hiring competent and properly trained construction contractors and by strict adherence to the site safety plan.

The OSWER Directive No. 9355.0-19 states, "Remedies must be protective of human health and the environment. This means that the remedy meets or exceeds ARARs..." EPA has determined that the selected remedy will meet all ARARs identified for the 11th and Umatilla properties. In addition, from the analyses conducted in the Public Health and Environmental Assessment and the Public Health Evaluation of Remedial Alternatives and because of the permanence associated with the design of the offsite disposal facility, EPA has concluded that the selected remedy would be protective of public health and the environment.

Consistency With Other Laws: Pursuant to SARA Section 12.(d), remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further release which at a minimum assures protection of human health and the environment. In addition, remedial actions shall, upon their completion, reach a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attains legally applicable or relevant and appropriate Federal standards, requirements, criteria, or limitations, or any promulgated standards, requirements, criteria, or limitations under a State environmental or facility siting law that is more stringent than any Federal standard (ARARs).

On November 20, 1986, EPA requested that the State of Colorado identify potentially applicable or relevant and appropriate State public health and environmental requirements for the Card Corporation property, (OU X). The State responded to this request on January 21, 1987, with a list of Colorado requirements which pertained to the entire Denver Radium Site.

EPA classified all Federal and State public health and environmental requirements applicable or relevant and appropriate to the 11th and Umatilla properties into three categories: contaminant-specific ARARs, action-specific ARARs, and location-specific ARARs. A description of each of these categories is provided in both Section 4 and Appendix C of the Operable Unit II FS. Other Federal and State criteria, advisories, and guidance were also considered. Tables C-1 through C-4 in Appendix C of the Operable Unit II FS contain a brief description of each

potential Federal and State requirement identified and EPA's analysis of each requirement's applicability or relevance and appropriateness to the 11th and Umatilla properties. EPA has determined that the selected remedy will meet all applicable or relevant and appropriate public health and environmental requirements of Federal and State laws and, therefore, no SARA Section 121(d)(4) waivers need be invoked. A brief discussion of ARARs for the 11th and Umatilla properties is provided below.

The EPA Standards for Remedial Action at Inactive Uranium Processing Sites, 40 CFR Part 192, are one of two contaminant-specific ARARs identified for the 11th and Umatilla properties. For properties contaminated with uranium processing residues, these standards establish limits for the gamma radiation level and annual average radon decay product concentration in any occupied or habitable building and for the radium concentration in soil on open lands. Although not necessarily applicable to the 11th and Umatilla properties since the standards apply only to certain specifically designated sites where uranium was processed, the standards are relevant and appropriate to the 11th and Umatilla properties because (1) it is the radium content of the uranium mill tailings which is regulated; (2) the waste products resulting from uranium ore processing are very similar to those from both radium and vanadium ore processing; (3) the residues from both processes enter the environment through the same exposure pathways; and (4) the adverse health concerns resulting from exposure to the residues from both processes are the same.

The portion of the standards relevant and appropriate to the contaminated soil on the 11th and Umatilla properties and the portion which serves as EPA's target residual level for cleanup is 40 CFR Section 192.12 which states:

"Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site:

(a) the concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than -

(1) 5 pCi/g, averaged over the first 15 centimeters of soil below the surface, and
(2) 15 pCi/g, averaged over 15 centimeter-thick layers of soil more than 15 centimeters below the surface."

(40 CFR Section 192.12)

The portion of the standard relevant and appropriate to the buildings on the 11th and Umatilla properties is 40 CFR Section 192.12(b) which states:

(b) In any occupied or habitable building -

(1) The objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL, and
(2) The level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour.

(40 CFR Section 192.12(b).)

The second contaminant-specific ARAR identified for the 11th and Umatilla properties is the Nuclear Regulatory Commission Standards for Protection Against Radiation, 10 CFR Part 20. These regulations establish standards for protection against radiation hazards arising out of activities under licenses issued by the Nuclear Regulatory Commission (NRC). Because these standards apply to licensed NRC facilities, they are not applicable to the 11th and Umatilla properties. However, EPA has determined that portions of the regulations are relevant and appropriate to individuals who would be conducting the remedial action on the 11th and Umatilla property. In addition, these regulations are incorporated by reference in the Occupational Safety and Health Administration Standards, 29 CFR Parts 1910 and 1926, which, due to the mandate contained in SARA Section 126, now apply to employees involved in responses covered by CERCLA.

Of particular importance is Appendix B of 10 CFR Part 20 which provides limits for airborne concentrations of natural uranium, thorium-230, and radium-226. Gamma radiation dose standards for individuals in restricted and unrestricted areas are cited in 10 CFR Sections 20.101 and 20.105, respectively. These 10 CFR Part 20 standards along with the 40 CFR Part 192 standards are summarized in Table 5.

EPA has identified one potential location-specific ARAR for the 11th and Umatilla properties, the Executive Order on Flood Plain Management, 40 CFR Section 6.302(b), which requires Federal agencies to evaluate the potential effects of actions they may take in a flood plain to avoid, to the maximum extent possible, the adverse impacts associated with the direct and indirect development of a flood plain. Remediation of the contamination of the 11th and Umatilla properties is not likely to have an adverse effect in the event of a flood especially since having the contaminated material in a properly engineered and designed land-storage facility will reduce the chance that contaminated material would be spread during a flood. Currently there are no identified State location-specific ARARs for the 11th and Umatilla properties.

Table 5

POTENTIAL CONTAMINANT-SPECIFIC ARAR'S
OPERABLE UNIT II, DENVER RADIUM SITE

Regulatory Agency	Type of Contaminant	Standard, Requirement, Criteria, or Limitation	Comments
FEDERAL			
U.S. EPA-40 CFR 192, Subpart B-Standards	Radium-226 Concentration	5 pCi/g above background within 15 cm of the surface measured over a 100-m^2 area 15 pCi/g above background within subsequent 15 cm layers measured over a 100-m^2 area	Standards for cleanup of open lands or buildings; concentration of radium-226 in land, averaged over any area of 100 square meters. Point of compliance is at any contaminated area greater than 100 m^2. However, during cleanup all contaminated area would be remediated.
	Gamma radiation[a]	20 μR/hr above background	Relevant and appropriate to indoor gamma radiation. Point of compliance is inside any site building.
	Radon Decay Product Concentration	0.02 WL annual average 0.03 WL maximum	Relevant and appropriate to indoor radon. Point of compliance is inside any site building.
Nuclear Regulatory Commission (NRC) 10 CFR 20	Uranium-natural Airborne Concentrations	5 pCi/m^3, Unrestricted area[b] 100 pCi/m^3, Restricted area[c]	Point of compliance is any location within site.
	Thorium-230 Airborne Concentrations	3 pCi/m^3 Unrestricted area[b] 30 pCi/m^3, Restricted area[c]	Point of compliance is any location within site.
	Radium-226 Airborne Concentrations	3 pCi/m^3 Unrestricted area[b] 30 pCi/m^3, Restricted area[c]	Point of compliance is any location within site.
	Gamma radiation[a]	5 rem/yr, (5,000 mrem/yr) Restricted area[c] 500 mrem/yr, Unrestricted area[b]	Point of compliance is any location within site; site would be unrestricted for remediation workers.

[a] Relevant and appropriate standard but not as protective as Other Guidance; see Table 4-3.

[b] An unrestricted area is regarded as any place around a waste consolidation/storage area facility where access is not controlled.

[c] A restricted area is regarded as any place around a waste consolidation/storage area where access is controlled.

Action-specific ARARs are technology-based restrictions triggered by specific types of remedial measures under consideration. Once the remedial action alternatives were developed in the Operable Unit II FS, EPA identified specific action elements which were part of at least one or more of the alternatives. These action elements are listed in Section 6 of the Operable Unit II FS. EPA then identified numerous action-specific ARARs for each of the action elements. These action-specific ARARs were evaluated in Appendix C of the Operable Unit II FS and are presented in Table 6-2 of the Operable Unit II FS.

In addition to the ARARs mentioned above, EPA also considered other Federal and State criteria, advisories, and guidance in determining the appropriate degree of cleanup for the 11th and Umatilla properties. In particular, EPA considered the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP) recommendation for maximum gamma radiation dose to the whole body. This dose, 100 mrem/yr, is for chronic exposure to the general public, excluding natural background and medical radiation. This recommended level is more protective than the level established by the NRC in its regulations (10 CFR Part 20), and will be used in evaluating exposures to those working on the site but who are not associated with the cleanup of the 11th and Umatilla properties.

SARA Section 121(d)(3) codifies EPA's offsite disposal policy, which requires that offsite disposal of any hazardous substances, pollutants, or contaminants from a Superfund site take place only at a facility that is in compliance with applicable Federal law and all applicable State requirements. Furthermore, the unit to which these wastes are transported must not be releasing any hazardous waste or constituent to ground water, surface water, or soil, and any such releases from other units at the facility must be controlled by an approved corrective action program. It is incumbent upon the State of Colorado, as part of its CERCLA Section 104(c)(3) obligations, to assure the availability of a disposal facility which is in compliance with EPA's offsite disposal policy.

Cost-effectiveness and Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable: Alternative 6, Onsite Temporary Land Storage, Offsite Permanent Disposal, is a cost-effective remedial action alternative which effectively mitigates and minimizes threats to and provides adequate protection of public health and the environment. The results of this alternative cannot be achieved by the methods envisioned in the two alternatives which were less costly, Alternatives 1 and 2. Alternative 7 and Alternative 9 would be equally effective but much more expensive to implement than Alternative 6.

The selected remedy will address the principal threat at the 11th and Umatilla properties. However, the selected remedy does not satisfy the statutory preference for treatment as a principal element. As part of the selection of remedy process, EPA evaluated permanent solutions to the hazards associated with the specific substances present on the 11th and Umatilla properties. However, since the hazardous substance associated with the 11th and Umatilla properties is a radioactive element, the number of treatment technologies which may successfully reduce the mobility, toxicity, and volume of the hazardous substance is extremely limited. The characteristic of spontaneously emitting energy and subatomic particles is a property inherent to each atom of a radioactive element and which cannot be altered or destroyed by any chemical or physical treatment known today. Most treatment and resource recovery technologies concentrate the radioactive elements present in the waste, increasing toxicity without sufficiently reducing volume or mobility. These treatment and resource recovery technologies will leave a waste product which is still radioactive. Nonetheless, EPA considered several treatment and resource recovery technologies in the technology scoping and screening phase and even the initial alternative screening stage of the Operable Unit II FS. However, no technology was found which would result in a permanent and significant decrease in the toxicity, mobility, and volume of the hazardous substance, radium, which is present on the 11th and Umatilla properties.

Future Actions

The future remedial activities that are required to complete remedial action at the 11th and Umatilla properties are:

(1) Design remedial action.

(2) Enter in to State Superfund Contract with State of Colorado.

(3) Conduct temporary remedial actions for contamination present on 11th and Umatilla properties.

(4) Select and, if necessary, design and construct permanent disposal facility. (This activity is to be conducted by State of Colorado.)

(5) Remove contaminated material from the 11th and Umatilla properties and transport it to the permanent disposal facility.

(6) Confirm that the 11th and Umatilla properties have been decontaminated to conform with the requirements of ARARs and can be made available for unrestricted use.

Schedule

Dates for completing key milestones leading to remedial action at the 11th and Umatilla properties are highlighted below:

(1) Complete design of remedial action by September 30, 1988.

(2) Finalize State Superfund Contract with State of Colorado by September 30, 1988.

(3) Initiate remedial action no later than during first quarter fiscal year 1989.